



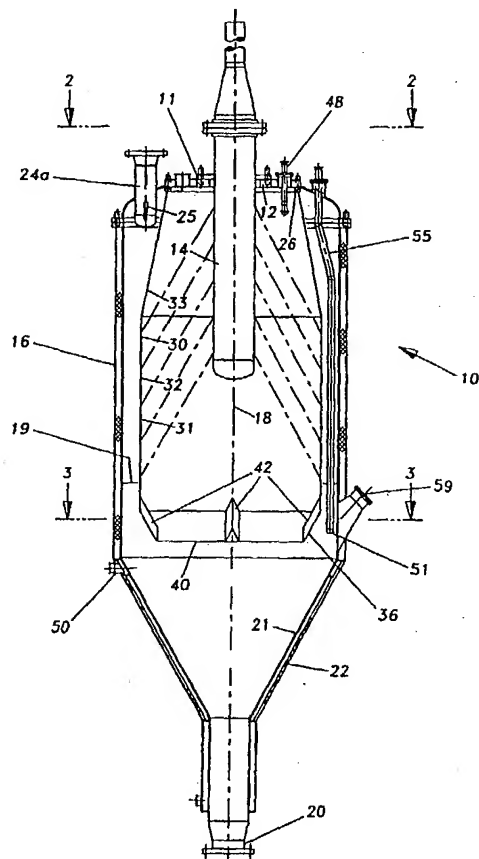
INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁷ : A23C 9/00, A23L 3/00, B01F 3/00		A1	(11) International Publication Number: WO 00/56161
			(43) International Publication Date: 28 September 2000 (28.09.00)
(21) International Application Number: PCT/US00/07448 (22) International Filing Date: 22 March 2000 (22.03.00) (30) Priority Data: 09/273,713 22 March 1999 (22.03.99) US (71)(72) Applicant and Inventor: ZIMMER, Artur, G. [US/US]; 11118 Proud Foot Place, Columbia, MD 21044 (US). (74) Agents: TALAVULL, W., Warren et al.; Farkas & Manelli PLLC, 7th floor, 2000 M Street NW, Washington, DC 20036-3307 (US).		(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG). Published With international search report.	

(S4) Title: APPARATUS AND METHOD FOR TREATMENT OF FLUENT FOOD PRODUCTS

(S7) Abstract

An apparatus and method of the heat treatment of a fluent food product with steam includes a pressure vessel (10) having a steam inlet (24a) at one end and a product outlet (20) at the opposite end; an inner partition wall (30) having an open end defines the product introduction and treatment chamber and includes a fluid distribution device (14) adapted to provide a plurality of discrete turbulent sprays that impact in a turbulent manner on the interior surface of the partition wall to then flow downwardly to the open end in a turbulent manner while steam flows upwardly toward a vent (72) located at the top of the treatment chamber; balanced flow of steam is effected by apertured baffles (19) extending between the interior wall of the vessel and the partition wall.



FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece			TR	Turkey
BG	Bulgaria	HU	Hungary	ML	Mali	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MN	Mongolia	UA	Ukraine
BR	Brazil	IL	Israel	MR	Mauritania	UG	Uganda
BY	Belarus	IS	Iceland	MW	Malawi	US	United States of America
CA	Canada	IT	Italy	MX	Mexico	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NE	Niger	VN	Viet Nam
CG	Congo	KE	Kenya	NL	Netherlands	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NO	Norway	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	NZ	New Zealand		
CM	Cameroon			PL	Poland		
CN	China	KR	Republic of Korea	PT	Portugal		
CU	Cuba	KZ	Kazakhstan	RO	Romania		
CZ	Czech Republic	LC	Saint Lucia	RU	Russian Federation		
DE	Germany	LI	Liechtenstein	SD	Sudan		
DK	Denmark	LK	Sri Lanka	SE	Sweden		
EE	Estonia	LR	Liberia	SG	Singapore		

APPARATUS AND METHOD FOR TREATMENT OF FLUENT FOOD PRODUCTS

5

Field of the Invention

The present invention relates to an apparatus for heat treatment of liquid food products to reduce the bacterial count in the product without materially affecting the organoleptic qualities of the product and to a method for carrying out the treatment in an efficient manner. Additionally, the invention relates to a method for the high heat treatment of milk products for the purpose of denaturing the protein content of the milk.

15 Background of the Invention

For many years, workers in the food industry have endeavored to increase the shelf life of a variety of food products while assuring the safety of the products for human consumption. Various sterilization techniques have been employed in the food industry to this end. Of these, the most popular has been heat sterilization particularly in conjunction with treatment of fluent products. In this regard, the maintenance of aseptic conditions guaranteeing the success of the sterilization process as well as control of other process parameters have been important to assure the effectiveness of the sterilization. For some types of food products, such as milk, careful handling of the product throughout the processing is mandatory not only for health reasons but also for the preservation of the desirable taste and other organoleptic properties of the product. These requirements have long been a significant cost factor in the marketing of the product.

30

In connection with denaturing the protein in milk products, that is, reduction of the Whey Protein Nitrogen Index (WPNI), high temperatures have been necessary in order to reduce the holding time and to allow greater flexibility in meeting differing product specifications such as for milk powder. It

is desirable that the heat treatment be effected with minimal changes in color, taste and without production of burnt particles.

To achieve denaturing of the protein for the production of high heat
5 milk powder (WPNI < 1.5), in the past, cumbersome and expensive equipment
has been employed and which required that the fluid milk product be
maintained at approximately 80° C for approximately 30 minutes. More recent
developments have used temperatures up to 120° C for much shorter holding
intervals on the order of two minutes. However, even at these higher
10 temperatures and shorter holding times, problems persist in terms of burn-on
on the process equipment surfaces resulting in shorter operating cycles and
lower quality products. Also, more frequent cleaning cycles are required.

The use of high temperatures has been limited by the unavailability of
15 suitable heaters that could correlate with the volume capacity of other
downstream equipment such as evaporators and dryers which now operate at
capacities of 100,000 kg/hr or more of milk feed. One manufacturer has
developed a fluid distribution head for milk sterilization that allows higher flow
rates and as a result higher temperatures can be used such as on the order of
20 143°C. This translates into a shorter holding time of less than 30 seconds for
the same degree of denaturation as previously attained at lower temperatures
noted above. Also, at or about 143°C, the bacterial killing rate is the same as
for ultra high temperature and extended shelf life products and will improve
the shelf life of the powdered milk product.

25 Ultra high heat (UHT) and extended shelf life (ESL) products require a
bacterial killing rate that can be accomplished for low heat milk powders
(WPNI . 6.0) by using the same high sterilizing temperatures (143 ° C) but it is
necessary that the holding times be shorter such as on the order of 2 to 6
30 seconds.

Representative of the prior art are U.S. patents Nos. 4,310,476,
Reissue 32,695, 4,591,463 and 5,544,571.

It has been found of particular importance that a fluent food product in conjunction with treatment with the sterilizing medium be handled in a manner that assures intimate contact on a molecular level between the medium such as steam and the fluent food product. As is well known, a milk product exhibits particular sensitivity to sterilization techniques. Even small temperature and other process variations during the treatment of milk can result in large changes in the taste of the product which risks rendering the product unacceptable to consumers. Moreover, marketing unsterilized milk establishes a price floor against which sterilized milk must compete. As a result, workers in this field have endeavored to provide a cost competitive technique for sterilizing milk and other fluent food products. However, while the theory of heat treatment of such products has been well tested, efficient production techniques have not been provided nor have apparatus and methods been developed that can effectively render a high quality sterilized product competitive in the market place with low temperature pasteurized liquid products.

Summary of the invention

In the invention, a pressure vessel is provided that has a longitudinal axis that, in use, is vertically oriented. At or near the top of the vessel, a fluid distribution device is removably mounted so as to extend into the vessel into a primary treatment zone that is defined by an inner partition wall that is open at a lower end thereof that is spaced above the bottom end of the pressure vessel. One or more steam inlets are located adjacent the upper end of the vessel so as to introduce sterilizing steam into the space between the wall of the pressure vessel and the outer surface of the partition wall that encloses the primary treatment zone. The fluid distribution device is preferably a hollow body or housing that is substantially cylindrical with an array of nozzles mounted in staggered positions about the surface of the housing. The nozzles are designed to distribute fluid introduced into the housing from a source under relatively high pressure in the form of triangularly shaped, flat sprays that are projected downwardly toward the partition wall at a selected angle of from about 45 to 60°. Each spray pattern is regulated by the pressure and the

nozzle design to contact the partition wall without any significant contact between adjacent spray patterns. The ejection under pressure of the fluent material from each nozzle induces turbulence which, on contact with the partition wall, continues as turbulent flow of the material downwardly to the bottom edge of the partition wall toward the material outlet at the bottom of the pressure vessel. The combination and sequence of high turbulence jet spray, impact on a wall and forced falling film flow down that same wall is employed to maintain turbulence in the flow during the entire heating process and prevent formation of a liquid stream or film which allows temperature differences to exist between a hotter surface of the stream and cooler core. The heating process is completed as the product leaves the product chamber typically less than one second after entering it.

According to the method of this invention, the fluent material to be treated is fed under pressure to the distribution device. From the nozzles of the distribution device, a plurality of distinct angularly defined flat sprays that do not significantly impinge on one another are projected across and at an angle to the flow of a sterilizing medium. The fluent material is then impacted on the partition wall and flows downwardly in counter flow relation to the rising sterilizing medium. A fraction of the sterilizing medium is vented from the upper portion of the pressure vessel to effect removal of non-condensable gases that are desorbed from the fluent material and from the condensing steam.

The apparatus and process of the invention will provide a gentle but highly efficient heat treatment of the fluent material at high production rates while allowing production costs to be reduced. This is due in part to the reduced physical size and the ease of maintenance of the apparatus as compared to prior art devices used for the same purpose. Moreover, the apparatus will ensure turbulence in the movement of the fluent material from emission from the nozzles to removal from the pressure vessel. This will significantly improve heat transfer along with the counter flow motion of the heating medium and the fluent material being treated and will allow the reduction in size of the apparatus while permitting significant improvement in

production capacity.

The foregoing and other advantages of the invention will become apparent as consideration is given to the following detailed description taken
5 in conjunction with the accompanying drawings, in which:

Brief Description of the Drawings

Figure 1 is a sectional view in elevation of the pressure vessel and
10 fluent distribution device;

Figure 2 is view along lines 2-2 of Figure 1;

Figure 3 is plan view along lines 3-3 of Figure 1;

Figure 4 is an enlarged view in elevation of the fluent distribution
device;

15 Figure 5 is a schematic view in sectional elevation of a nozzle mounted in the fluent distribution device;

Figure 6 is top plan view of a portion of the fluent spray pattern used in the present invention. The dashed lines represent the projection of the triangular patterns on a certain plane with the dash dot dash lines
20 representing the triangular patterns on the planes below and above thereby displaying the staggered overlap of the patterns;

Figure 7 is schematic, elevational view of portions of the steam system and pipe supply system for food products and cleaning in place (CIP) solutions;

25 Figure 8 is top plan view of the systems of Figure 7; and

Figure 9 is a detailed view of part of the steam balancing baffle.

Figure 10 is a schematic illustration of a flow path of the milk product through a series of evaporators to a dryer to manufacture powdered milk product with the sterilizer of this invention.

30

Detailed Description of the Invention

Referring to the drawings, there is shown in Figure 1 a sectional view of a pressure vessel generally designated at 10. The vessel is provided with

a top wall 11 provided with an opening 12 through which a fluent distribution device 14 can be mounted to extend along the longitudinal axis 18 of the vessel 10. Typically, the vessel will have a side wall 16 which is covered with an insulation jacket. At its lower end, the vessel 10 is provided with a fluent material outlet 20 extending along the axis 18 and located at the apex of conical wall 21 surrounding the axis 18. The conical wall 21 may be enclosed in a cooling jacket 22 over at least a major portion of its surface area.

A pair of inlets 24a and 24b for a sterilizing medium such as steam is provided adjacent the upper end or top wall 11. The inlets may be in the shown form of cylindrical tubes having slot openings 25 spaced about the wall of each tube in a pattern that avoids direct impact of the steam on to the conical upper portion 33 of the product treatment chamber 31.

In this arrangement, extending from a support ring or the periphery 26 of top wall 11 is a partition wall 30 shaped to surround the axis 18 and which is of a radial dimension to be located radially inwardly of the interior surface of wall 16 of the vessel 10. The partition wall 30 defines a product treatment chamber 31 as described below. With this arrangement as shown in Figure 1, the flow of steam will proceed downwardly in the space provided between the wall 16 of the vessel 10 and the outer surface of the partition wall 30. One or more balancing baffles may be provided on the interior surface of vessel 16 as at 19. As for clearly shown in Fig. 9, the baffles, which completely cover the annular space formed by wall 16 and wall 30 about the axis 18 of the vessel 10, are provided with a plurality of perforations 23. With this construction, the baffles will serve to distribute and balance the turbulent steam flow. The baffles 19 may be perforated with different numbers of and sizes of holes to achieve this.

As is well understood in this technology, the outer surface of the pressure vessel 10 may be covered by an insulation layer to reduce energy loss and to protect the operators.

The partition wall 30 is preferably in the form of an open ended tube

having a substantially cylindrical middle portion 32, moderately conical upper portion 33 which is closed by top wall 11 and which will be provided with an opening for receiving the fluent distribution device 14, described in more detail below. In the lower end portion of the partition wall 30, a conically shaped wall section 36 is located which terminates at a lower edge 40 located not lower than the level where wall 16 of the vessel 10 and conical wall 21 of the vessel are connected. As shown in Figures 1 and 3, interiorly of section 36, flow controlling baffles 42 may be provided evenly spaced about axis 18 on the interior wall of section 36 to control the flow of the fluent material to the lower edge 40 and to generate gaps in the fluent material stream for controlled passage of the steam from the annular space and into the lower inlet of the product chamber 31.

Referring to Figure 2, the upper wall 11 of the vessel 10 is provided with a plurality of openings such as at 44 and 46. The openings 44 are provided to allow visual inspection of the interior of the vessel while the openings 46 are provided in the upper wall and are supplied with installed spray nozzles 48 for cleaning the interior of the product chamber 31 and are of a size to allow venting from the interior of product chamber 31 enclosed within partition wall 30. Such venting allows removal of non-condensable gases and will intensify the counter-flow pattern of fluent material and steam. Control of the internal pressure is maintained in the range of 0.5 to 5 bar depending on the heat treatment being carried out. At the lower end of the cylindrical portion of the vessel 10, there may be provided several cooling water nozzle mountings 50 only one of which is shown. In the upper portion of the vessel 10 radially outside the ring 26, spray nozzle mounts and nozzles as at 51 are provided. The nozzles may be installed with an extension 55 to facilitate cleaning adjacent a inspection sight glass 59. Sight glasses may be installed at selected positions to allow inspection of the operation and to allow a determination when cleaning is required.

With reference to Figure 4, an enlarged view of the fluent material distribution device 14 is shown. The device 14 is provided with a flange 54 which encompasses a centrally located inlet 52, the upper end of which is

open and connectable with a flange 56 to a conduit to supply the fluent material such as milk to be treated to the interior of the device 14. The device 14 includes a cylindrical wall 58 which is symmetrical about a longitudinal axis 66 and is formed with a plurality of rows of openings two of which are indicated at 60 with the openings communicating with the hollow interior of the device 14. The opening 12 in the top wall 11 of the vessel 10 and partition wall 30 is located so that the axis 66 of the device 14 will lie on the axis 18 of the vessel 10 and of the partition wall 30. It is important that the openings 60 of one row be offset or staggered relative to the openings of an adjacent row and that a distance of between 25 mm and 75 mm be provided between the rows of openings 60.

The openings may each be threaded to receive a nozzle 62 of the type having an exterior threaded portion. The nozzles can then be interchanged to provide different flow patterns to accommodate different fluids with differing viscosities and at different flow rates. Alternatively, the nozzles may be inserted with an interference fit or welded in position in each opening. In cases where for sanitary reasons threads are not allowed in the product contact area, the entire device 14 can be inter changed with alternated devices with welded nozzles designed for different products and operating cases. As shown in Figure 5, each nozzle will be positioned in its associated opening 60 with axis 64 extending at an angle of between 30° and 60° and preferably between 45° and 60° to the axis 66 of the device 14. Thus, since the axis 66 of the device 14 lies on the axis 18 of the vessel 10 and the axis of the product chamber 31, the spray pattern will be projected into the vessel 10 at substantially the same angle provided that sufficient pressure is used. The pressure used should be sufficient to provide a flat, V-shaped spray at high turbulence over the entire distance between the nozzle and the wall of product chamber 31. The angle of the V-spray pattern may vary between 15° and 30° , measured at the nozzle exit. The nozzles are selected so as to provide a well-defined flat spray pattern at a rated fluid pressure and this will, of course, depend on the dimensions of the equipment. By way of example, with an interior diameter of approximately 1000 mm for the partition wall 30 and an external diameter of approximately 200mm for the device 14, an angular

spray pattern 68 as shown in plan view in Figure 6 may be achieved for each row of nozzles in each opening 60 of the device 14. The pressure should be selected so that the spray pattern 68 from one nozzle will not significantly impinge or interfere with the adjacent spray patterns from adjacent nozzles either in the same row or from rows above or below. As shown in Figure 6, spaces are provided between the spray patterns thereby forming channels for the rising steam as it travels toward the vents at 48 at the top of the product chamber 31. Only several of the patterns are shown in Fig. 6 for clarity. That is to say, the spray pattern in one row 68 of nozzles (dashes) will be angularly offset from the spray pattern of a vertically adjacent row 69 (dot/dashes) This arrangement affords controlled interaction between the steam and fluent material being treated. Nozzles for effecting this type of pattern are commercially available from a number of sources. Upon impact with the interior surface of wall 32, re-amplified turbulence will result before turbulent flow down the interior surface of the partition wall 30 commences. Since the flow of steam is upwardly in the volume inside the partition wall, intimate contact with the fluent material will be assured during this segment of the passage of the material. The ratio of steam volume to the liquid volume in the chamber 31 should be maintained in the range of 25 - 75 to 1. The fluent material passes down from the lower edge 40 of the partition wall 30. The flow of material is broken up by the baffles 42 and a number of these sufficient to allow free passage of the steam into the product chamber 31 without significant deflection of the liquid stream will be provided. At this point, the fluent material has reached the intended final temperature before passing out of the system at 20.

The wall 32 of the partition wall 30 and wall 33 may be thermally isolated from the heat of the incoming steam to avoid liquid burning onto hot spots that may be forming on the interior surface of the product chamber 31. This may be done in a number of ways including insulation layers or a water cooling jacket as is done with the conical portion 21 at 22.

Teflon coatings or other non-stick coatings may be applied to the interior surface of the product chamber 31 to provide additional protection

against burn on.

Referring to Figure 7, there is shown a supply system 61 for a cleaning medium such as water, caustic solutions and acid solutions. In use, a cleaning medium is fed through the supply pipe 63 and enters the system 61 at 67a and 67b by operation of control devices 70. At one or more points of the pipes for system 61, closable vents such as at 72 are provided. During a food handling operation, these vents will be opened to remove non-condensable gases generated during a sterilizing process. During the cleaning process, the vents 72 may be closed intermittently to prevent loss of the cleaning chemicals.

In Figure 8, the steam supply conduit system 81 is shown for supplying both steam inlets 24a and 24b with steam from a source (not shown).

In Figure 9, there is shown a detailed view of a portion of one of the baffles 19 located between the inner wall of pressure vessel 10 and the outer surface of partition wall 30. The baffle is attached to the inner wall of pressure vessel 10 but just clears the outer surface of the partition wall 30 to allow removal of the partition wall for maintenance of the apparatus. Where 2 or 3 baffles 19 are installed, they should be spaced apart along the axis of the vessel 10. As indicated above, the surface of each baffle 19 is perforated as at 23 over substantially its entire surface to better control the flow of steam to the inlet of the product chamber 31. The apertures or perforations 23 may be sited and distributed in a variety of patterns depending on the volume of the vessel and production throughput of steam required. In one form, the size of perforations will decrease in diameter as the distance from the steam inlet increases to create a pressure head above each of the baffles.

The invention will allow a process that is well adapted to production of high heat powdered milk at bacterial killing rates comparable to ultra high heat and extended shelf life processes but at holding times in the holding tubes of 30 seconds or less. More significantly, the process of this invention allows the production of a low heat powder with bacterial killing rates comparable to UHT and ESL processes but with holding times of 5 seconds or less. This will result

in a longer shelf life for the milk powder. It is achievable by virtue of the capacity of the heater of this invention to handle efficiently larger volumes of the milk product than the prior art devices. In either case, the method of this invention will enable a producer to substantially match the throughput capacity
5 of the evaporators and dryers used in the making of powdered milk using the same sterilizing equipment for both the high and low heat processes. Thus, the capital investment in powdered milk production will be reduced, the production flexibility will be increased and due to the longer shelf life, the marketability of the powder will be improved.

10 According to the process, as schematically shown in Figure 10, fresh milk at flow rates up to and exceeding 100,000 kg/hr is fed to an evaporator of conventional construction comprising one or more stages. The flow through the sterilizer and through the holding tubes described above may be interposed at any point along the evaporation path or at the inlet end or at the
15 exit end. The residence time in the product holding tube 83 can easily be achieved and controlled by adjusting the length of the tube according to the residence time required for different types of heat treatment. At the end of the last evaporation stage, the product, which will have typically started at 8% to 13% total solids (TS) per weight unit, will now be typically 40% to 55% TS and
20 the product flow rate will have shrunk according to the amount of water removed from the product in the evaporation process.

The product is then passed to a dryer facility where it is converted to powder, which then is packaged into bags or stored in bulk containers.

25

If re-infection of the sterile product is to be avoided on its way to the dryer (final dehydration of the fluent concentrate), all equipment downstream of the holding tube, including the dryer feed system, has to be of aseptic design and must be operated such as to maintain aseptic conditions. A
30 schematic layout of such a system is shown in Figure 10 where the vessel 10 and the holding tube 83 are shown in broken lines at a number of the sites where it may be disposed relative to the bank of evaporator stages 82. It will be understood that only one such site need be used. The evaporated product is passed to dryer 84 and then to packaging or bulk storage.

The invention is applicable to the treatment of a variety of dairy products including skim milk, partial skim milk, condensed skim and whole milk, cream, ice cream mixes and milk shakes. In addition, the invention may
5 be employed with process cheese base, whole whey and whey blends and whey protein concentrate. Fruit juices and their concentrates as well as mixes of fruit and dairy fluids may be treated. Gelatin and mixes of gelatin, fruit and flavorings may be treated.

10 Having described the invention, a number of modifications will become apparent to those skilled in this art and it will be understood that these are within the scope of the appended claims.

What is claimed is:

1. An apparatus for treating a fluent material with a heated fluid comprising a
5 pressure vessel, dispensing means mounted within said vessel for distributing
the fluent material in a selected pattern including a plurality of spaced apart
sprays, fluid outlet means coupled to said vessel for withdrawing treated fluent
material therefrom, said vessel having a longitudinal axis extending
substantially vertically, an upper portion having an inlet for the fluent material
10 to be treated, said inlet being connected to said means mounted within said
vessel for distributing the fluent material, said vessel having an inlet for said
heated fluid, baffle means within said vessel for regulating the distribution of
the heated fluid in said vessel and an outlet for any non-condensable gases
generated during the treatment at the upper portion of said vessel.
15
2. The apparatus as claimed in claim 1, wherein said dispensing means
comprises a hollow housing connected to said inlet, said pressure vessel
having an interior surface surrounding said housing with said housing having
dimensions said such that a selected distance is present between the surface
20 of said housing and said interior surface of said pressure vessel.
3. The apparatus as claimed in claim 2, wherein said housing has a
longitudinal axis and said housing is located so that said longitudinal axis of
said housing lies along said longitudinal axis of said pressure vessel.
25
4. The apparatus as claimed in claim 2, wherein said housing has a
peripheral surface and a longitudinal axis, said peripheral surface having a
plurality of circumferential rows of apertures formed therein with the apertures
of one row being offset vertically relative to the apertures of an adjacent row.
30
5. The apparatus as claimed in claim 4, wherein each of said apertures is
provided with a fluid distribution nozzle.
6. The apparatus as claimed in claim 5, wherein each of said nozzles is

provided with a distribution opening for projecting the fluid material passing there through in a flat spray pattern having substantially the same angular width.

- 5 7. The apparatus as claimed in claim 6, wherein an interior chamber is provided in said pressure vessel having a lower open end facing said outlet of said pressure vessel, the angular width of the spray pattern is selected so that each spray pattern from each nozzle contacts said interior chamber of said pressure vessel without any substantial contact between adjacent spray
10 patterns from adjacent nozzles.

8. The apparatus as claimed in claim 6, wherein each nozzle is directed at an acute angle to the longitudinal axis of said housing.

- 15 9. The apparatus as claimed in claim 8, wherein said acute angle is in the range of 30 degrees and 60 degrees.

10. The apparatus as claimed in claim 7 wherein said interior chamber has a selected diameter and said distributing means has a diameter in the range of
20 10 to 20% of said selected diameter.

11. The apparatus as claimed in claim 1 wherein at least one baffle is provided between the interior wall of said vessel and said partition wall.

- 25 12. The apparatus as claimed in claim 11 wherein apertures are provided in the surfaces of said baffle.

13. The apparatus as claimed in claim 12 wherein a plurality of said baffles are spaced apart along the axis of said vessel and the size of said apertures
30 in said baffles decreases in size as the distance from said inlet for the heated fluid increases so as to provide a pressure head above each of said baffles.

14. A method of subjecting a fluent material to heat treatment using a pressure vessel of a type having inlets adjacent one end for a heating medium

and the fluent material to be treated, a partition wall defining a chamber and having an open end and in which a fluent material distributor is located, comprising the steps of a) introducing the heating medium in the vessel at a point outside the partition wall, b) venting a portion of the heat medium from the one end of the vessel through said chamber, c) introducing fluent material from said distributor into said chamber to allow the fluent material to come into contact with the heating medium flowing through the chamber in counter flow to the direction of movement of the heating medium.

10 15. The method as claimed in claim 14 including the step of distributing the fluent material in said chamber in the form of a plurality of highly turbulent, discrete sprays distributed about said fluent material distributor.

15 16. The method as claimed in claim 15 including the step of impinging the sprays on the partition wall to cause the sprays to break up and to flow downwardly to an edge of said partition wall and including the step of locating baffles about said partition wall to control the flow of the material to the edge of the partition wall.

20 17. A method for subjecting a fluent food product to heat treatment using a pressure vessel of a type having inlet means adjacent one end of the vessel for a heating medium and a partition wall defining a treatment chamber having a fluent food product distribution device attached to an inlet for the food product adjacent the one end of the vessel, the treatment chamber having an open end located in spaced relation to the inlet means, comprising the steps of: a) introducing the heating medium into the vessel at a point outside the partition wall, b) venting at least a portion of the heating medium from one end of the vessel through the treatment chamber so as to establish a flow direction for the heating medium in the treatment chamber from the open end toward the one end of the vessel, c) introducing the fluent food product from the distribution device in the form of a plurality of substantially discrete flat sprays directed at the interior wall of the treatment chamber with a pressure sufficient to cause the sprays to impact against the interior wall of the treatment chamber while still turbulent.

18. The method as claimed in claim 17 including the step of directing the sprays at an acute angle to the interior wall of the treatment chamber.
- 5 19. The method as claimed in claim 18 wherein said acute angle is in the range of 45 degrees and 60 degrees.
20. The method as claimed in claim 17 including the step of providing spaces between the sprays to allow the heating medium to pass through the spaces
- 10 so provided.
21. The method as claimed in claim 17 including the step of venting the heating medium and any non-condensable gases from the one end of the vessel and treatment chamber.
- 15 22. The method as claimed in claim 17 including the step of using steam as the heating medium.
23. The method as claimed in claim 17 including the step of using a dairy
- 20 product as the fluent food product.
24. The method as claimed in claim 23 wherein the dairy product is milk.
24. A method of producing a powdered milk product from fresh milk
- 25 comprising the steps of feeding the fresh milk to an evaporator having one or more stages and either before or after at least one evaporator stage, subjecting the milk to heat treatment using a pressure vessel of a type having inlet means adjacent one end of the vessel for a heating medium and a partition wall defining a treatment chamber having a fluent
- 30 food product distribution device attached to an inlet for the food product adjacent the one end of the vessel, the treatment chamber having an open end located in spaced relation to the inlet means, and introducing the heating medium into the vessel at a point outside the partition wall, venting at least a portion of the heating medium from one end of the

- vessel through the treatment chamber so as to establish a flow direction for the heating medium in the treatment chamber from the open end toward the one end of the vessel, introducing the fresh milk from the distribution device in the form of a plurality of substantially discrete flat sprays directed at the interior wall of the treatment chamber with a pressure sufficient to cause the sprays to impact against the interior wall of the treatment chamber while still turbulent, removing the milk product from the vessel and passing the product to a dryer.
- 5
25. The method as claimed in claim 24 including the step of maintaining the milk in holding tubes between 2 seconds and 30 seconds.
- 10
26. The method as claimed in claim 25 wherein the step of maintaining the milk in holding tubes is for approximately 5 seconds.
27. The method as claimed in claim 24 including the step of using a plurality of evaporator stages and selecting a site among the stages, including before a first one and after the last one of the stages and positioning the vessel to receive milk product at that site and after heat treatment, passing the milk product to a subsequent stage.
- 15

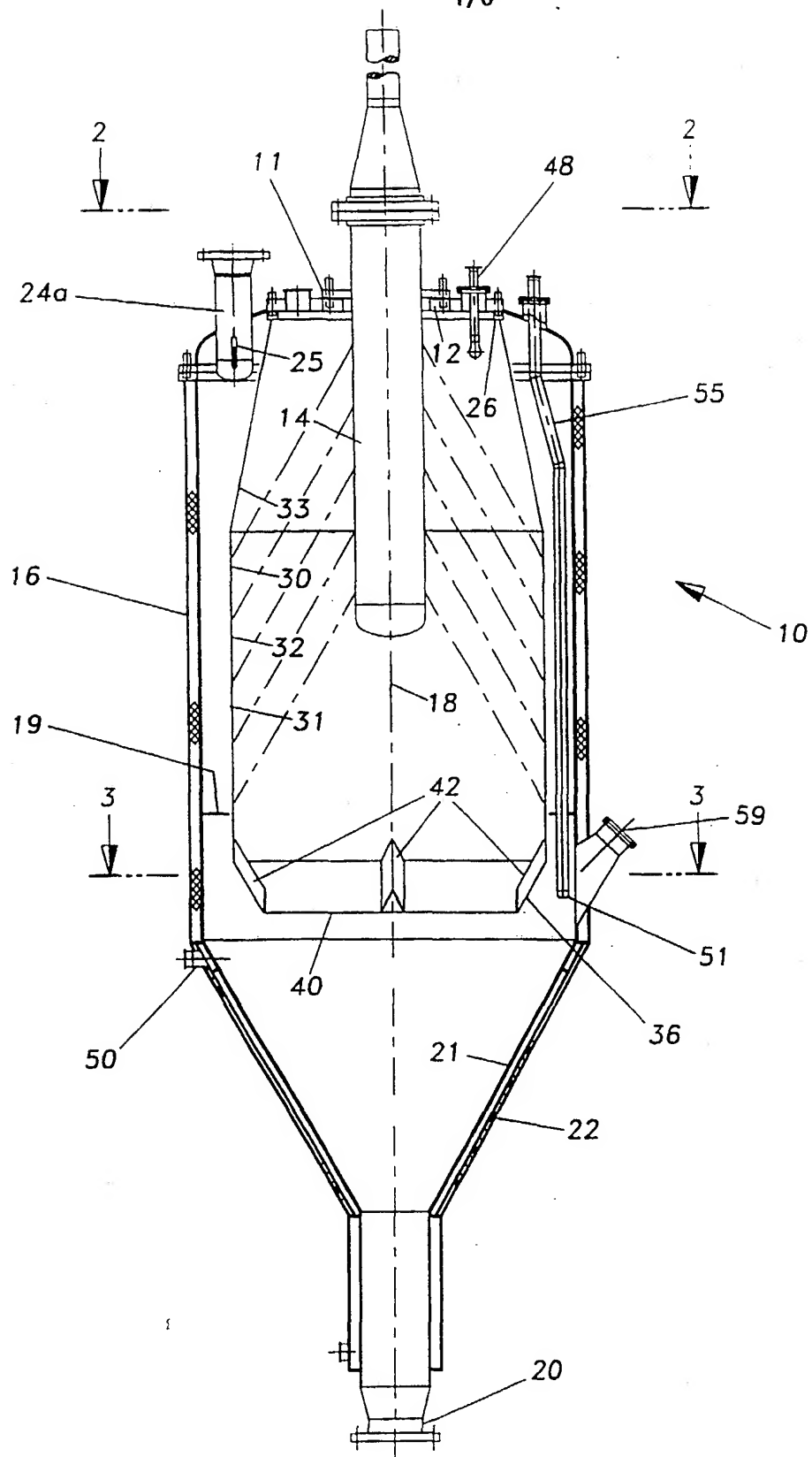


FIG. 1

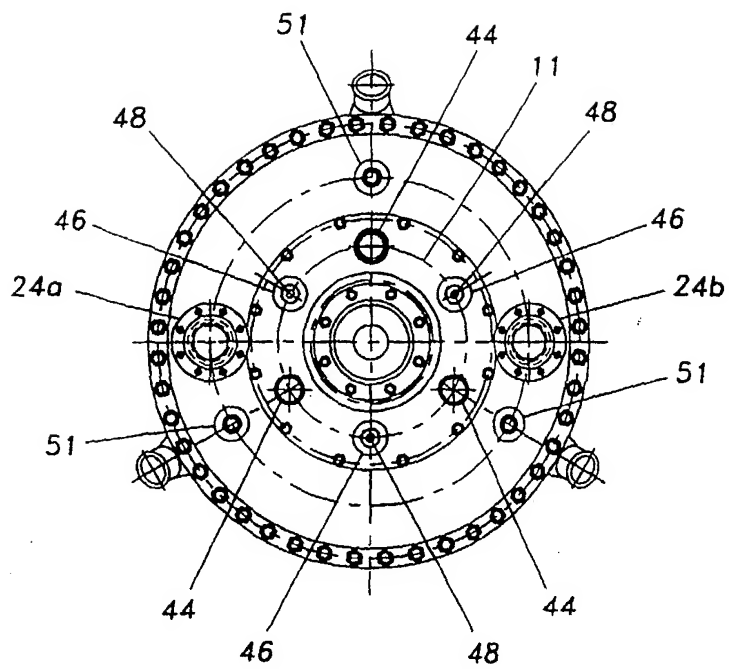


FIG. 2

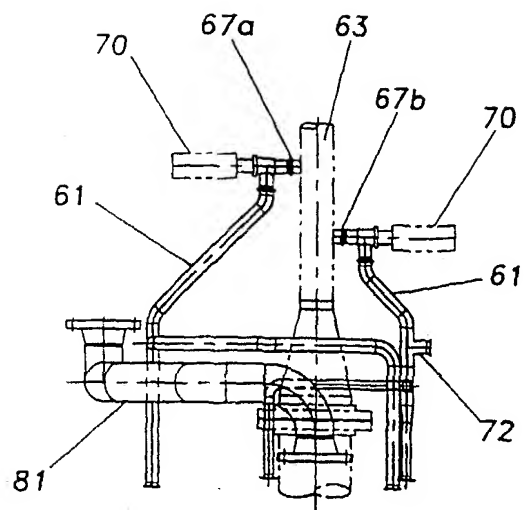


FIG. 7

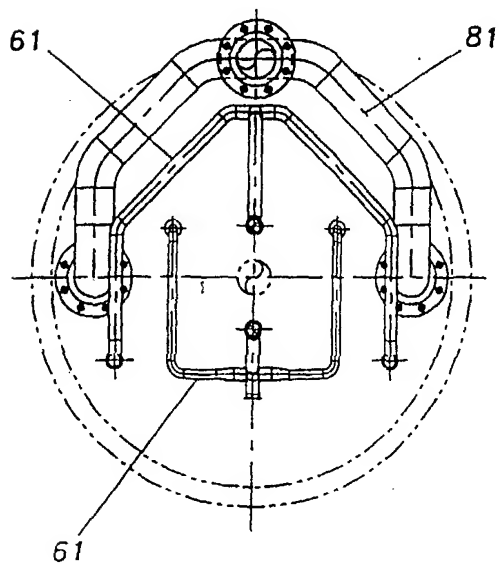


FIG. 8

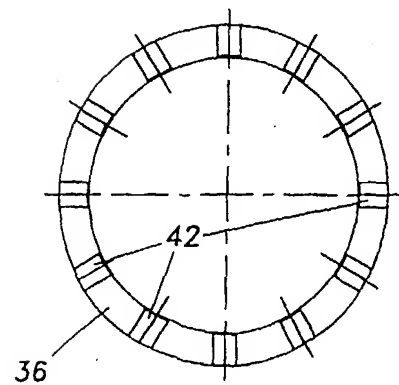
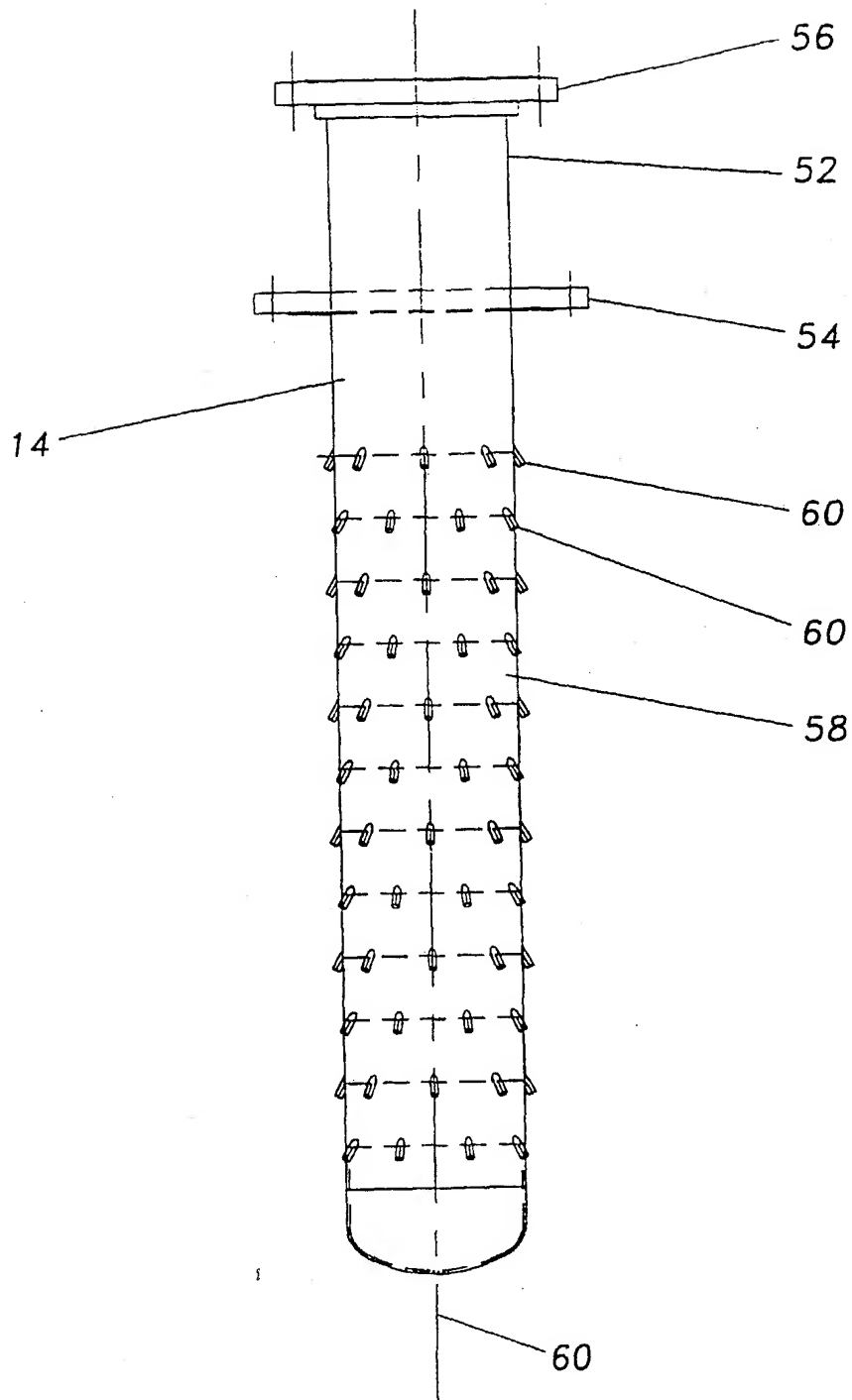


FIG. 3

FIG. 4

4/6

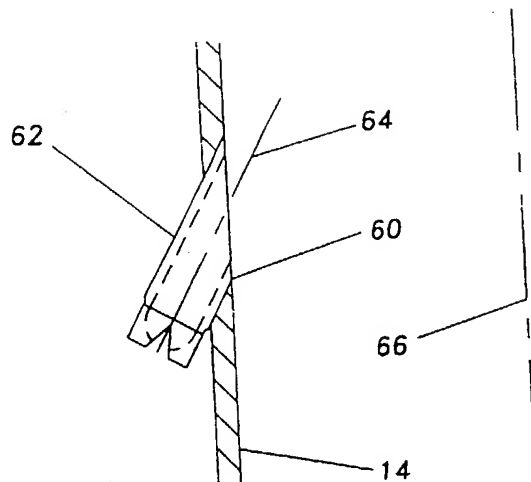


FIG. 5

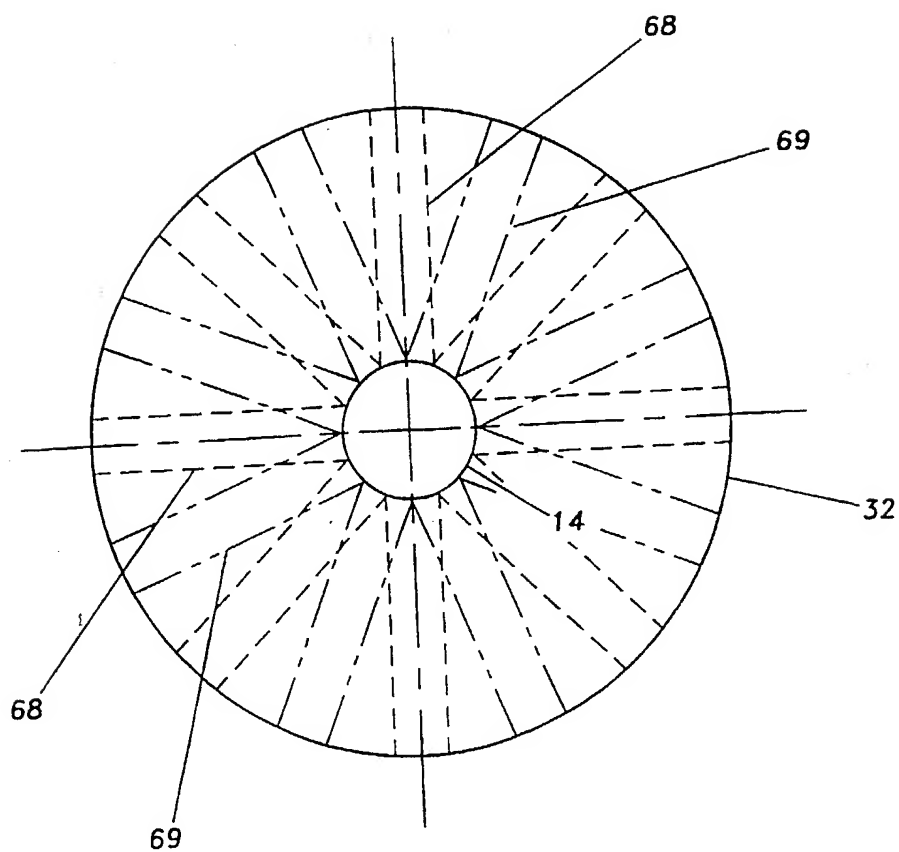
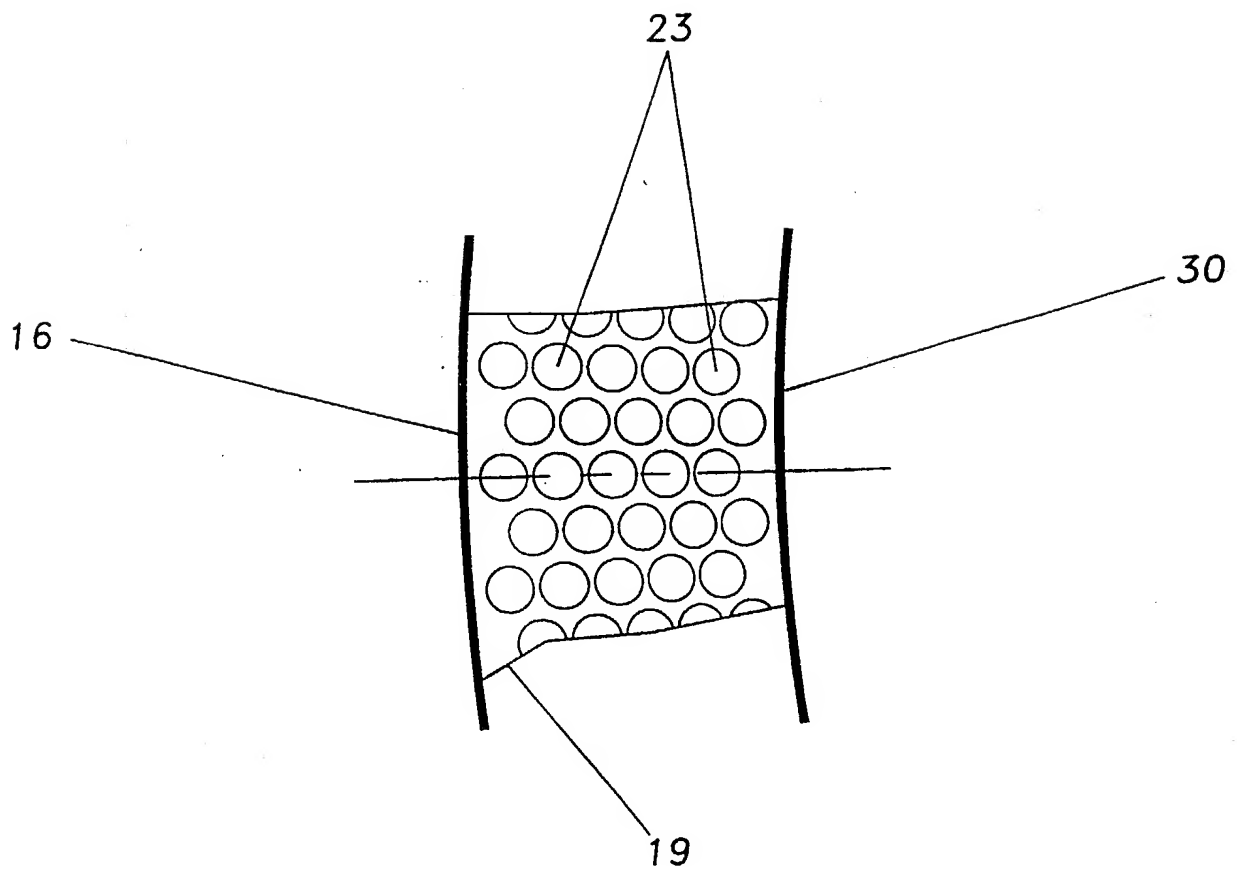
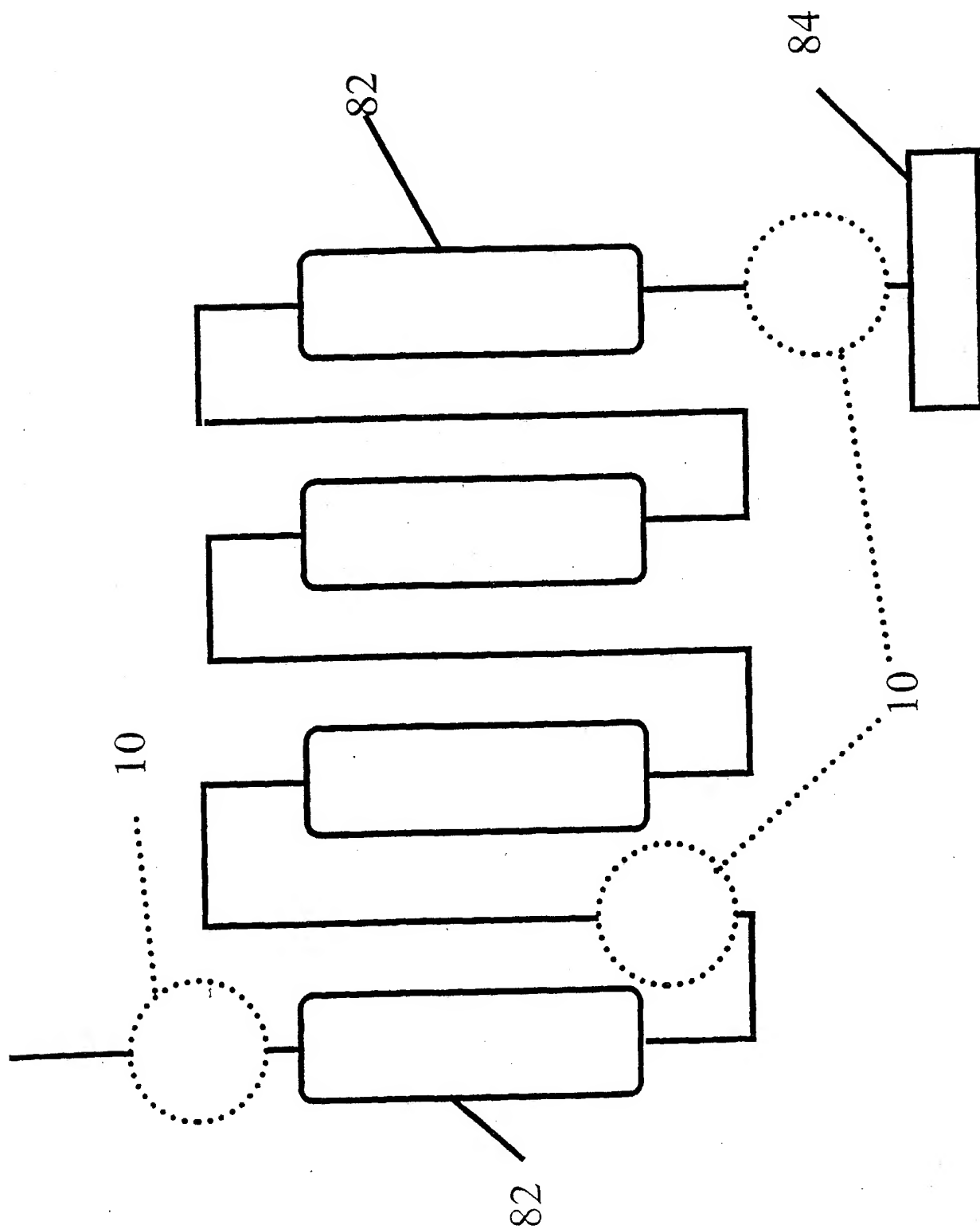


FIG. 6

FIG. 9



A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : A23C 9/00; A23L 3/00; B01F 3/00

US CL : 426/511, 471, 522; 99/452, 467, 483; 261/117, 118

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 426/511, 521, 522, 471, 476; 99/452, 467, 483; 261/115, 117, 118; 422/26

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US, 2,389,005 A (SEBALD) 13 November 1945, see the entire document.	1-6, 14-16
A, P	US, 5,989,437 A (ERIKSSON et al) 23 November 1999.	7-13
A	US, 4,490,403 A (PISECKY et al) 25 December 1984.	17-27

☐ Further documents are listed in the continuation of Box C.
 ☐ See patent family annex.

* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "B" earlier document published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed		"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family
---	--	--

Date of the actual completion of the international search

19 MAY 2000

Date of mailing of the international search report

29 JUN 2000

 Name and mailing address of the ISA/US
 Commissioner of Patents and Trademarks
 Box PCT
 Washington, D.C. 20231

Facsimile No. (703) 305-3230

Authorized officer

GEORGE C. YEUNG

Telephone No. (703) 308-3848

XP-002173623

AN - 1983-793917 [42]

CPY - MOMD

DC - D13

FS - CPI

IC - A23B5/00

IN - BRAZHNIKOV A M; BULGAKOV N I; KOSMODEMYA Y U V

MC - D03-A03

PA - (MOMD) MOSCOW MEAT DAIRY INST

PN - SU982637 A 19821228 DW198342 002pp

PR - SU19802977897 19800825

XA - C1983-101895

XIC - A23B-005/00

AB - SU-982637 Egg powder is produced by subjecting egg mass to evaporation and then spray-drying. The foam stability is improved and the nutrient value of the product is increased by subjecting the egg mass, before the evaporation, to heating at 45-62 deg. for 20-60 min.

- The above heating operation results in decomposition of practically whole carbonic acid present in the egg mass whereby the pH of the mass increases to 7.9-9.0. This effect suppresses the growth of microorganisms. Pasteurisation occurs jointly with evapn.; the stirring speed can be reduced to 20-120 rpm. Bul.47/23.12.82 (2pp Dwg.No 0/0)

IW - EGG POWDER PRODUCE EVAPORATION EGG MASS FOLLOW SPRAY DRY THERMAL TREA STORAGE STABILISED

IKW - EGG POWDER PRODUCE EVAPORATION EGG MASS FOLLOW SPRAY DRY THERMAL TREA STORAGE STABILISED

INW - BRAZHNIKOV A M; BULGAKOV N I; KOSMODEMYA Y U V

NC - 001

OPD - 1980-08-25

ORD - 1982-12-28

PAW - (MOMD) MOSCOW MEAT DAIRY INST

TI - Egg powder prodn. - includes evapn. of egg mass followed by spray-drying and thermal treatment for storage stability

